Annals of Clinical and Analytical Medicine
Original Research

Survival outcomes and prognostic factors in stage 2 and 3 colorectal cancer: Comparing elective and emergency surgical approaches

Cem Batuhan Ofluoğlu[1], Fırat Mülküt[2]
[1] Department of Gastrointestinal Surgery
[2] Department of General Surgery, Faculty of Health Sciences, Sancaktepe Sehit Prof. Dr. İlhan Varank Training and Research Hospital, Istanbul, Turkiye

Abstract

Aim: This study aimed to compare the survival outcomes of Stage 2 and Stage 3 colorectal cancer (CRC) patients undergoing emergency versus elective surgery and to identify critical prognostic factors influencing survival rates.

Material and Methods: We retrospectively analyzed 323 CRC patient records from January 2015 to March 2017, focusing on factors like tumor grade, lymphovascular and perineural invasion, mucinous component, perforation, tumor size, and lymph node count. Exclusions were made for incomplete data, palliative surgeries, and non-standard surgical margins. Survival analysis was performed using Kaplan Meier and logistic regression, with a p-value <0.05 indicating statistical significance.

Results: Of the 181 patients analyzed, 60.2% were stage 2, and 39.8% were stage 3. Emergency surgery correlated with reduced survival in both stages. Notably, stage 2 emergency patients had fewer lymph nodes removed and higher incidences of tumor perforation and perineural invasion (p = 0.01, 0.001, 0.014, respectively). For stage 3, vascular invasion was significantly more common in the emergency group (p = 0.017). Multivariate analysis underscored lymph node count, tumor perforation, and perineural invasion as significant for stage 2 (p = 0.040, 0.012, 0.002, respectively), while vascular invasion was critical for stage 3 (p = 0.023).

Discussion: Emergency CRC surgery is associated with lower survival rates and more aggressive tumor features. These findings suggest that elective surgery may offer a survival advantage in CRC due to less aggressive tumor features, underlining the need for prompt diagnosis and surgical intervention. Future studies should focus on optimizing preoperative care and exploring postoperative strategies to improve outcomes for emergency surgery patients.

Keywords

Colorectal Cancer, Emergency Surgery, Elective Surgery, Prognostic Factors, Stage 2-3

DOI: 10.4328/ACAM.22496 Received: 2024-11-20 Accepted: 2024-12-24 Published Online: 2025-01-20 Printed: 2025-02-01 Ann Clin Anal Med 2025;16(2):133-138

Corresponding Author: Cem Batuhan Ofluoğlu, Department of Gastrointestinal Surgery, Faculty of Health Sciences, Sancaktepe Sehit Prof. Dr. İlhan Varank Training and Research Hospital, Istanbul, Turkiye.

E-mail: dr.cemofluoglu@gmail.com P: +90 532 366 57 27

Corresponding Author ORCID ID: https://orcid.org/0000-0002-0670-8590

Other Authors ORCID ID: Fırat Mülküt, https://orcid.org/0000-0003-4049-7595

This study was approved by the Ethics Committee of Kartal Dr. Lütfi Kırdar City Hospital (Date: 2023-03-29, No: 2023/514/246/24)

Introduction

In 2022, colorectal cancer (CRC) ranks as the fourth most commonly diagnosed cancer and the second leading cause of cancer-related deaths in the USA [1]. Surgical resection remains the standard of care for non-metastatic CRC. Despite the routine treatment with radical surgery and adjuvant chemotherapy applied today, the survival outcome in CRC is heterogeneous and not satisfactory. The 5-year survival rate for patients diagnosed with local CRC is 90.1%, for those with regional lymph node involvement, it is 69.2%, while for patients with distant metastasis, the rate drops to 11.7% [2]. Currently, the strongest tool for assessing prognosis following potentially curative surgery is the pathological examination of the specimen. Although the depth of tumor invasion, the number of positive lymph nodes, and the presence of metastasis determine the pathological stage and are the strongest predictors of prognosis, other clinical, molecular, and histological features can independently affect the prognosis regardless of the stage. Approximately 33% of patients with CRC still present in the hospital, requiring urgent intervention due to conditions that necessitate acute care, despite widespread screening programs and endoscopic procedures [3]. Obstruction, haemorrhage, and perforation are the most common indications for emergency CRC surgery, with obstruction being the most frequent at 77% [4]. Emergency colorectal operations are associated with higher mortality and morbidity compared to elective surgery [5]. While some studies suggest that emergency colorectal resection is associated with poor oncological outcomes, others report no difference in prognosis [6-8].

The Clinical Practice Guidelines Committee of the American Society of Colon and Rectal Surgeons has identified three goals that need to be addressed in the treatment of emergent cases of CRC: (1) to eliminate the adverse effects of the condition that necessitates emergency intervention; (2) to achieve the best possible tumor control; and (3) to prepare the patient for adjuvant or systemic therapy as soon as possible [9].

In our study, we aimed to compare the survival of patients with CRC who underwent emergency or elective surgery at the same stage (stage 2 or 3) and to identify other parameters that affect survival independent of the stage.

Material and Methods

Data from 323 patients who underwent surgery for CRC at a tertiary referral hospital between January 2015 and March 2017 were retrospectively analyzed. Factors including grade, lymphovascular invasion, perineural invasion, mucinous component presence, perforation, tumor size, the number of lymph nodes excised, and the number of metastatic lymph nodes (for stage 3 patients) were determined through pathological examination of the specimens. Pieces exhibiting any extracellular mucin were assessed as containing a mucinous component, irrespective of the amount of extracellular mucin secreted. The staging was conducted using the pathological staging criteria from the NCCN's February 25, 2022, Version 1. 2022 publication for colon cancer. According to the College of American Pathologists Consensus Statement [10], patients were classified into two categories: well-moderately and poorly. Conventional adenocarcinoma is characterized by glandular formation, which forms the basis for histologic tumor grading: well-differentiated adenocarcinoma shows >95% gland formation; moderately differentiated adenocarcinoma has 50%-95% gland formation; and poorly differentiated adenocarcinoma is mostly solid with <50% gland formation. Patients' survival data were accessed from a national database. Tumor localization was categorized into right colon and left colon, with tumors located in the proximal two-thirds of the transverse colon recorded as right colon and those further distal noted as left colon tumors. Patients excluded from the study were those with missing data, those who underwent palliative surgery, those who received total abdominal colectomy, those with positive surgical margins (1 cm for distal rectal cancer, 5 cm for proximal rectal cancer, 10 cm distal margin for colon cancer, and 10 cm proximal margin for all CRC), those who died perioperatively without discharge, stage I patients (due to insufficient numbers for comparison in emergency surgery), and stage IV metastatic patients.

All statistical analyses were performed using SPSS (Statistical Package for Social Sciences) for Windows version 25.0. Normality was assessed using Skewness and Kurtosis tests and graphical methods. Data were expressed as mean ± standard deviation if normally distributed and median with min-max values if not. Additionally, data were presented as counts (n) and percentages (%). The Chi-square test was utilized for comparing two categorical variables. Fisher's Exact Test was employed if the Chi-square test did not have a sufficient number of patients for comparison. When comparing a categorical variable with a numerical value, the Independent Sample T-test was used for normally distributed numerical values, while the Mann-Whitney U test was applied for non-normally distributed numerical values. Survival comparisons between patients at the same stage were conducted using Kaplan Meier survival analysis. Logistic regression analysis was used to compare data between emergency and elective patients. Both multivariate and univariate analyses were performed using logistic regression. A p-value of <0.05 within a 95% confidence interval was considered statistically significant.

Ethical Approval

This study was approved by the Ethics Committee of Kartal Dr. Lütfi Kırdar City Hospital (Date: 2023-03-29, No: 2023/514/246/24).

Results

Our analysis covered 181 CRC patients, distinguishing 60.2% at stage 2 and 39.8% at stage 3. Notably, the age distribution and lymph node removal followed a normal distribution, contrasting with the non-normal distribution of tumor size and positive lymph node count.

Survival analysis revealed that stage 2 and 3 patients had reduced rates after emergency surgery (as depicted in Figure 1 and Figure 2).

The mean age for stage 2 was 64.72 years, with an average of 21.55 lymph nodes resected. The median tumor size for this group was 5.51 cm. Gender was nearly evenly split with a slight male predominance (51.4%), and tumors were more commonly found in the left colon (67%). Most tumors were well-moderately differentiated (91.7%), with a minority showing

vascular invasion (20.2%) and perforation (9.2%). Perineural invasion was present in nearly a third of the cases (29.4%), and a mucinous component was seen in 24.8% of the stage 2 patients (Table 1).

For stage 2 patients, those undergoing emergency surgery had significantly fewer lymph nodes removed (p = 0.01) and higher rates of tumor perforation (p=0.001) and perineural invasion (p = 0.014). Age differences between emergency and elective surgery groups were not statistically significant (p = 0.125). The presence of poorly differentiated tumors, vascular invasion, and mucinous components between the emergency and elective surgery groups showed no statistical significance, with p-values of 0.083, 0.469, and 0.522, respectively (Table 1).

Stage 3 patients had an average age of 63.21 years and an

Table 1. Clinical and demographic features

		Stage 2			Stage 3		
		Emergent n=42(38.5%)	Elective n=67(61.5%)	p	Emergent n=23(31.9%)	Elective n=49(68.1%)	p
Age (years), mean±sd		67.81±17.74	62.78±15.77	.125	67.13±16.95	61.37±14.43	.140
Dissected Lymph Node, mean±sd		18.79±8.13	23.28±9.12	.010a	19.43±8.41	22.43±7.50	.133
Metastatic Lymph Node, median (min-max)		-	-	-	3 (1-10)	2 (1-18)	.220
Tumor Size (cm), median (min-max)		5 (2- 10.5)	5 (2- 13)	.675	4.5 (3.2- 9.5)	4.5 (0-14)	.426
Sex, n (%)	Male	22 (52.4)	34 (50.7)	.868	11 (47.8)	29 (59.2)	.366
	Female	20 (47.6)	33 (49.3)		12 (52.2)	20 (40.8)	
Tumor Localization, n (%)	Right	11 (26.2)	25 (37.3)	.229	8 (34.8)	20 (40.8)	.624
	Left	31 (73.8)	42 (62.7)		15 (65.2)	29 (59.2)	
Grade, n (%)	Poorly	1 (2.4)c	8 (11.9)	.083	3 (13.0)	4 (9.1)d	.684c
	Well-moderately	40 (97.6)	59 (88.1)		20 (87.0)	40 (90.9)	
Vascular Invasion, n (%)		7 (16.7)	15 (22.4)	.469	21 (91.3)	27 (55.1)	.002a
Perforation, n (%)		9 (21.4)	1 (1.5)	.001a b	3 (13.0)	3 (6.1)	.376b
Perineural Invasion, n (%)		18 (42.9)	14 (20.9)	.014a	16 (69.6)	22 (44.9)	.051
Mucinous Component		9 (21.4)	18 (26.9)	.522	2 (8.7)	12 (24.5)	.114

a Statistically significant at the confidence level of 0.95
b Fisher's Exact Test
c One missing case
d Five missing cases

Table 2. Stage 2 Patients Emergent vs Elective Surgery

	OR	95%CI		Univariate p	Multivariate p
Age	.992	.963	1.023	.018a	.621
Dissected Lymph node	1.065	1.003	1.131	.014a	.040a
Tumor Size	.922	.707	1.202	.593	-
Sex	1.529	.572	4.086	.868	-
Tumor Localization (Left-Right)	.470	.134	1.654	.232	-
Grade	.122	.010	1.449	.118	-
Perforation	.017	.001	.412	.007a	.012a
Vascular Invasion	1.292	.373	4.477	.470	-
Perineural Invasion	.178	.060	.528	.016a	.002a
Mucinous Component	1.154	.369	3.611	0.523	-

a Statistically significant at the confidence level of 0.95.

Table 3. Stage 3 Patients Emergent vs Elective Surgery

	OR	95%CI		Univariate p	Multivariate p
Age	.975	.933	1.017	.141	-
Dissected Lymph node	1.064	.969	1.168	.135	-
Metastatic Lymph Node	1.065	.838	1.353	.800	-
Tumor Size	.970	.707	1.330	.674	-
Sex	.698	.204	2.383	.367	-
Tumor Localization (Left-Right)	1.021	.257	4.046	.625	-
Grade	.629	.094	4.210	.617	-
Perforation	.421	.049	3.595	.332	-
Vascular Invasion	.113	.017	.743	.007a	.023a
Perineural Invasion	.594	.139	2.534	.055	.482
Mucinous Component	2.069	.277	15.448	.131	-

a Statistically significant at the confidence level of 0.95.

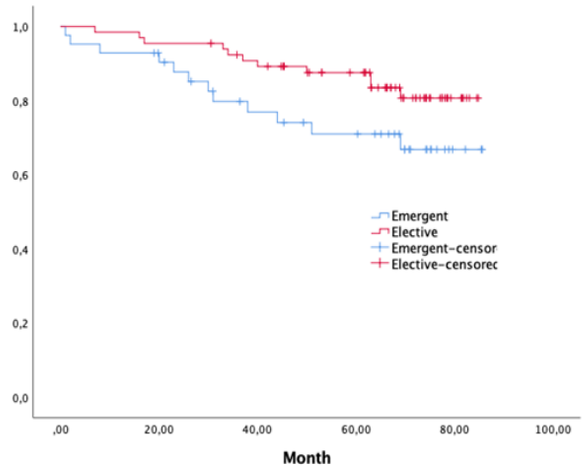

Figure 1. Kaplan-Meier Survival Analysis for Stage 2 Colorectal Cancer

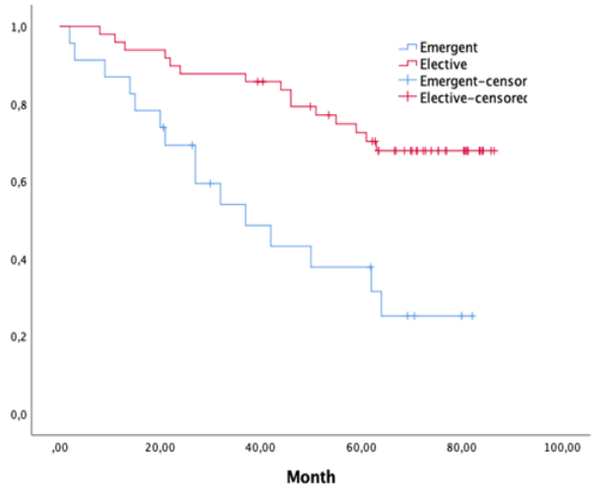

Figure 2. Kaplan-Meier Survival Analysis for Stage 3 Colorectal Cancer

average lymph node harvest of 21.47, with a median tumor size of 4.94 cm. Gender distribution was similar to stage 2, with a slight male predominance. Vascular invasion was seen in a higher proportion (66.7%), particularly in the emergency surgery group, which was a significant finding ($p = 0.017$). Perineural invasion was present in over half of the stage 3 patients (52.8%). The incidence of poorly differentiated tumors and the presence of a mucinous component showed no statistical difference between the emergency and elective groups ($p > 0.05$) (Table 1).

When comparing the emergency and elective surgery groups across various clinical and pathological factors in a multivariate framework, stage 2 patients showed significant differences in lymph node count, tumor perforation, and perineural invasion with p-values of 0.040, 0.012, and 0.002, respectively. Stage 3 analysis highlighted vascular invasion as a significant differentiating factor ($p = 0.017$). Other variables such as age, gender, tumor size, and mucinous component presence did not demonstrate significant differences (Tables 2 and 3).

Discussion

Our study found that in CRC patients undergoing emergency surgery, survival rates were lower at both stages compared to those operated electively. When comparing Stage 2 patients who underwent emergency and elective surgery, we observed fewer dissected lymph nodes in the emergency surgery group, while tumor perforation and perineural invasion were more common. Additionally, in the logistic regression analysis of Stage 2 patients undergoing emergency surgery, the number of dissected lymph nodes, the presence of tumor perforation, and perineural invasion were identified as independent risk factors for mortality, while age was found as a risk factor in univariate analysis.

In the Stage 3 group, vascular invasion was more frequently observed in patients undergoing emergency surgery compared to those with elective surgery. The logistic regression analysis among Stage 3 patients who had emergency surgery revealed that the presence of vascular invasion in the tumor was an independent risk factor for mortality on its own.

Emergency surgery in CRC is associated with higher morbidity, mortality, and poorer prognosis compared to elective surgery. A case-control study conducted in 2003 found that undergoing surgery in an emergency setting was an independent risk factor for both morbidity and mortality [11]. Another study indicated that 2-year disease-free survival was greater in patients who underwent elective surgery [12]. The lower survival rates in emergency surgical interventions are directly related to surgery generally being performed for complications such as obstruction, perforation, or haemorrhage, the biological behavior of the tumor, and the overall condition of the patient [13].

The role of age in the management of CRC is a significant concern in general surgical practice. In univariate analyses, age has emerged as a significant determinant of mortality in CRC patients. In elderly patients, the increase in comorbidities and the decreased capacity of the body to respond to cancer and treatment can affect treatment options and outcomes. Notably, the risk of surgical interventions and the rates of postoperative complications may be higher in older patients [14]. Additionally, age may influence the biological characteristics of CRC; for instance, some studies suggest that tumors may be more aggressive in older patients [15]. This is a critical factor in shaping general surgeons' approach to elderly CRC patients. Particularly, individualized treatment planning and comprehensive preoperative and postoperative assessments are necessary to achieve optimal outcomes in this population. The pronounced effect of age on mortality necessitates further development of age-specific treatment protocols and clinical decision-making processes.

It is well-known that lymph node dissection has prognostic value in CRC. The removal of a sufficient number of lymph nodes can improve patient survival rates and assist in accurately determining the stage of the disease. The consensus in the field is that at least 12 lymph nodes should be removed during CRC surgery [16]. In light of this information, the threshold has been exceeded for patients operated on both emergently and electively. However, the number is higher in patients who undergo elective surgery. The reasons for this outcome can be attributed to various factors. In emergency surgical operations, the surgeon's priority may be the hemodynamic

stabilization of the patient, which could influence the extent of lymphadenectomy, and the operations are generally more complicated with a higher risk of complications, potentially altering the surgeon's priorities.

Some studies in the literature suggest that the greater number of lymph nodes removed during elective operations could be due to the surgeon having the opportunity to perform a more meticulous and careful dissection [17]. Additionally, the more planned nature of elective operations allows the surgeon to be better prepared for the surgery, enabling a more comprehensive lymphadenectomy. In our study, while there was a statistically significant difference in the number of lymph nodes removed among stage 2 patients, this difference was not observed in stage 3 patients. We attribute this to the surgeon's ability to detect palpable lymph nodes during the operation and their diligence in performing a more extensive dissection.

The literature indicates that the need for emergency surgical intervention is often associated with more aggressive biological behavior of the tumor [3]. As a consequence of this aggressive biological behavior, one would expect a higher frequency of tumor perforation, perineural, and vascular invasion. In our study, these adverse prognostic factors were more frequently observed in patients who had undergone emergency surgical intervention.

Vascular invasion is known as a bad prognostic marker of lymph node metastasis in CRC [18]. This invasion is defined as the invasion of tumor cells into blood vessels. A study by Huh et al. has demonstrated that vascular invasion functions as an independent poor prognostic factor in patients with CRC [19]. Emergency surgical procedures are typically applied due to severe complications such as obstruction, perforation, or haemorrhage. This could lead to a more aggressive spread of the tumor to the surrounding vascular structures. As reflected in our study, this may result in increased rates of vascular invasion in patients undergoing emergency surgery. Thus, our findings are consistent with the existing literature. However, when examining the outcomes of the study, perforation and perineural invasion were found as independent risk factors in stage 2 patients, while vascular invasion was not. In contrast, in stage 3 patients, vascular invasion was identified as an independent risk factor, but not perforation and perineural invasion, opposite to stage 2 patients. This result could be due to the small number of patients. As there is no similar study in the literature comparing patients of the same stage who underwent emergency and elective surgery, we cannot comment on this finding. Comparative evaluations of these data with similar studies with larger patient populations to be conducted in the future would be valuable.

Limitation

Our study has some limitations. We didn't explore disease-free survival or specify the reasons for emergency surgeries like obstruction, haemorrhage, or perforation. The stress response from emergency surgeries, affecting both patients and doctors, can influence the tumor environment and potentially increase metastasis risk. Therefore, elective surgeries are preferable for better outcomes in Stage 2 and 3 CRC patients, when possible.

Conclusion

Our study shows that emergency surgery for stage 2 and 3 colorectal cancer (CRC) patients is associated with significantly bad survival outcomes compared to elective surgery. In stage 2 patients, emergency interventions were linked to a lower number of lymph nodes removed and a higher incidence of tumor perforation and perineural invasion, which are independent risk factors for poor prognosis. In stage 3 patients, vascular invasion was the primary independent risk factor affecting survival. These findings highlight the need for elective surgery whenever possible to achieve better oncological outcomes and suggest that emergency surgeries present additional challenges that affect patient prognosis.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or compareable ethical standards.

Funding: *None*

Conflict of Interest

The authors declare that there is no conflict of interest.

References

1. Siegel RL, Giaquinto AN, Jemal A. Cancer statistics, 2024. CA Cancer J Clin. 2024;74(1):12-49.

2. Siegel R, DeSantis C, Virgo K, Stein K, Mariotto A, Smith T, et al. Cancer treatment and survivorship statistics, 2012. CA Cancer J Clin. 2012;62(4):220-41.

3. Barnett A, Cedar A, Siddiqui F, Herzig D, Fowlkes E, Thomas CR. Colorectal cancer emergencies. J Gastrointest Cancer. 2013;44(2):132-42.

4. Teixeira F, Akaishi EH, Ushinohama AZ, Dutra TC, Netto SD, Utiyama EM, et al. Can we respect the principles of oncologic resection in an emergency surgery to treat colon cancer? World J Emerg Surg. 2015;10:5.

5. Sjo OH, Larsen S, Lunde OC, Nesbakken A. Short term outcome after emergency and elective surgery for colon cancer. Colorectal Dis. 2009;11(7):733-9.

6. Biondo S, Kreisler E, Millan M, Martí-Ragué J, Fraccalvieri D, Golda T, et al. Long-term results of emergency surgery for colon cancer compared with elective surgery. Cir Esp. 2007;82(2):89-98.

7. McArdle CS, Hole DJ. Emergency presentation of colorectal cancer is associated with poor 5-year survival. Br J Surg. 2004;91(5):605-9.

8. Kim J, Mittal R, Konyalian V, King J, Stamos MJ, Kumar RR. Outcome analysis of patients undergoing colorectal resection for emergent and elective indications. Am Surg. 2007;73(10):991-3.

9. Chang GJ, Kaiser AM, Mills S, Rafferty JF, Buie WD. Practice parameters for the management of colon cancer. Dis Colon Rectum. 2012;55(8):831-43.

10. Compton CC, Fielding LP, Burgart LJ, Conley B, Cooper HS, Hamilton SR, et al. Prognostic factors in colorectal cancer. Arch Pathol Lab Med. 2000;124(7):979-94.

11. Smothers L, Hynan L, Fleming J, Turnage R, Simmang C, Anthony T. Emergency surgery for colon carcinoma. Dis Colon Rectum. 2003;46(1):24-30.

12. Mun JY, Kim JE, Yoo N, Cho HM, Kim H, An HJ, et al. Survival outcomes after elective or emergency surgery for synchronous stage IV colorectal cancer. Biomedicines. 2022;10(12):3114.

13. Biondo S, Gálvez A, Ramírez E, Frago R, Kreisler E. Emergency surgery for obstructing and perforated colon cancer: patterns of recurrence and prognostic factors. Tech Coloproctol. 2019;23(12):1141-61.

14. Sninsky JA, Shore BM, Lupu GV, Crockett SD. Risk factors for colorectal polyps and cancer. Gastrointest Endosc Clin N Am. 2022;32(2):195-213.

15. Baidoun F, Elshiwy K, Elkeraie Y, Merjaneh Z, Khoudari G, Sarmini MT, et al. Colorectal cancer epidemiology: recent trends and impact on outcomes. Curr Drug Targets. 2021;22(9):998-1009.

16. Vather R, Sammour T, Zargar-Shoshtari K, Metcalf P, Connolly A, Hill A. Lymph node examination as a predictor of long-term outcome in Dukes B colon cancer. Int J Colorectal Dis. 2009;24(3):283-8.

17. Sarli L, Bader G, Iusco D, Salvemini C, Mauro DD, Mazzeo A, et al. Number of lymph nodes examined and prognosis of TNM stage II colorectal cancer. Eur J Cancer. 2005;41(2):272-9.

18. Guan Z, Zhang XY, Li XT, Sun RJ, Lu QY, Wu AW, et al. Correlation and prognostic value of CT-detected extramural venous invasion and pathological lymph-vascular invasion in colon cancer. Abdom Radiol. 2022;47(4):1232-43.

19. Huh JW, Lee JH, Kim HR, Kim YJ. Prognostic significance of lymphovascular or perineural invasion in patients with locally advanced colorectal cancer. Am J Surg. 2013;206(5):758-63.

How to cite this article:
Cem Batuhan Ofluoğlu, Fırat Mülküt. Survival outcomes and prognostic factors in stage ii and iii colorectal cancer: comparing elective and emergency surgical approaches. Ann Clin Anal Med 2025;16(2):133-138

This study was approved by the Ethics Committee of Kartal Dr. Lütfi Kırdar City Hospital (Date: 2023-03-29, No: 2023/514/246/24)